TECHNICAL SPECIFICATION FOR SPUN CONCRETE POLES

1) SCOPE :

This specification covers design manufacture testing and supply of pre stressed concrete circular spun poles/designed for a working load of 500 Kgs.

2) Applicable Standards :

The poles shall comply with the relevant provisions made in the following Indian Standards Specifications or the latest versions thereof, except when they conflict with the specific requirements in this specific requirement in this specification.

a. IS 1678-1978 – Specification for the stressed concrete poles for overhead power, traction and telecommunication lines.

b. IS 2905-1966 – Methods of test for concrete poles for overhead power and telecommunication lines.

c. IS 7321-1974 – Code of practice for selection, handling and erection of concrete poles for overhead power and telecommunication lines.

d. IS **13158**-1991 – Pre stressed concrete circular spun poles for overhead power.

Materials meeting any other authoritative standards which ensure an equal or better quality than the standards mentioned above will also be acceptable. In such cases, English version of the standard adopted should be enclosed to the offer.

3) Terminology:

For the purpose of this specification, the definitions of Average Permanent Load, Load Factor and Transverse Load at first crack, Ultimate Failure, Ultimate Transverse Load and Working Load shall be as per IS 1678 or any other equivalent International Standards.

4) Dimensions and Shape:

The poles shall be of hollow circular section with an outside taper of 1:65. The diameter and thickness shall be as per design requirements. The tolerances shall be as follows:

Outer diameter	+4,	(-) 2mm
Length	+50,	(-) 10mm

5) Cement:

5.1. High strength ordinary Portland cement conforming to IS:8112 or ordinary Portland Cement conforming to IS: 269-1976 or rapid hardening cement conforming to IS-804 1 E-1978 or any other equivalent International Standards shall be used, which shall have the following additional requirements:

a) Initial Setting Time : Not less than 30 minutes.
b) Final Setting Time : Not more than 600 minutes.

5.2 The minimum compressive strength of standard mortar cube with standard sand as per IS:650 at 7 days shall be 375 Kgs/cm square.
A minimum of 3 trial cubes shall be made with aggregate grading to be used for the approved design mix and the average compressive strength results at 7 days, shall be determined to assess the suitability of the cement for every batch of cement.

6) Aggregates:

Coarse and fine aggregates used for the casting of poles shall conform to IS:383 or any other equivalent international Standards. The nominal max size of aggregates shall in no case exceed 20 mm or 1/4th the minimum thickness of the pole, whichever is less., provided further that the size of aggregates shall be at least 5mm less than the spacing between the pre-stressing wires.

Each size of graded aggregate shall be stocked in different storage bins or stock piles and shall be mixed only after the quantity required for each size has been separately weighed. The storage bins or stock piles shall be under cover to protect from weather.

7) Water:

Water should be free from chlorides, sulphates, other salts and organic matter Potable water will be generally suitable.

8) Admixtures:

Admixtures should not contain calcium chloride or other chlorides and salts which are likely to promote corrosion of pre-stressing steel.

9) Reinforcement:

9.1 Reinforcing bars and wires used for the manufacture of prestressed concrete poles shall conform to the following Indian Standards or any other equivalent International Standards.

a. IS:1785(Part-I) Specification for plain hard drawn steel wire for prestressed concrete: Part-I cold-drawn stress relieved wire (second revision).

b. IS:1785(Part-II) – 1983 Specification for plain hard drawn steel wire for pre stressed concrete: Part-II as drawn wire (First revision).

c. IS:2090-1983 – Specification for high tensile steel bars used in pre stressed concrete (first revision).

d. IS:6003-1983 Specification for indented wire for prestressed concrete (first revision)

e. IS:6006-1983 specification for uncoated stress relieved strand pre stressed concrete (first revision).

9.2 The surface of all reinforcement shall be free from loose scale, oil, grease, clay or other material that may have deteriorating effect on the bond between the reinforcement and the concrete.

10) Concrete:

The concrete mix shall be designed to the requirement laid down for controlled concrete (also called design mix concrete) in IS-1343 (code of practice for pre stressed concrete) and 1S-456 (code of practice for plain and reinforced concrete) or any other equivalent International standards subject to the following special conditions.

a. Minimum works cube strength at 28 days should be at least 50N/mm square.
b. The concrete strength at transfer should be at least half the 28 days strength ensured in the design.

11) Design Requirements:

The pole shall be designed for the following requirements:

a. Factor of safety for the poles shall not be less than 2.0
b. The average permanent load shall be taken as 50% of the working load.

c. The F.O.S. against first crack load shall be 1.0

d. At average permanent load, permissible tensile stress in concrete shall be 3.0 N/mm square.

e. At the design value of first crack load, the hypothetical flexural tensile stress of M 50 concrete grade shall not exceed 6.3 N/mm square.

f. The maximum compressive stress in concrete at the time of transfer of pre stress shall not exceed 0.8 times the cube strength.

12) Moulds:

Moulds shall be of steel and or rigid construction to prevent distortion and so arranged as to provide smooth surfaces. The moulds shall not allow any leakage of cement grout during casting. The holes in the end plates for the HT wires shall be accurately drilled by jigs to ensure inter-changeability. The end plates shall be designed to withstand the forces arising out of the change in direction of pre-stressing wires during tensioning.

13) Tensioning of Wires:

13.1 The HT wires shall be placed axially at regular spacing along the circumference. The spacing shall be as per IS 1678 or any other equivalent to International Standards. While cutting in of HT wires will be by automatic machines, button heading and forming reinforcement cages shall be done manually.
13.2 Helical steel shall be 2.7mm dia MS wires and the pitch shall be 150mm.
13.3 The clear cover shall be 20mm

13.4 Pre-stressing shall be by automatic machines. Force shall be applied on the entire group of HT wires to ensure all wires are equally stressed.

13.5 The pre-stressing wires shall be stretched by an approved method. The anchoring of the stretched wires shall be such that during manufacture and until the wires are released, no slipping occurs. The force at the time of initial stretching shall in addition to imparting of designed prestress also be sufficient to overcome the friction on account of any change in the inclination of wires and slippage that might occur during the anchoring process which will have to be suitably compensated.

13.6 The tensioning of pre-stressing steel shall be carried out in a manner that will induce a smooth and even rate of increase of stress in the wires.

13.7 The force induced in the pre-stressing wires shall be determined by means of gauges attached to the tensioning apparatus and cross checked by extension to be achieved shall be determined in advance, based on trials conducted on representative samples of the wires as used in the poles. The accuracy of the devices for measuring of the tensioning force shall be within plus or minus 5%.

14) Mixing and Consolidation of Concrete.

14.1 Provision shall be made to measure the quantities of cement and of fine and coarse aggregates by weight only. The accuracy of the measuring equipment shall be plus or minus 3%. All the measuring equipments shall be maintained in clean, serviceable condition and its accuracy checked regularly. Modern high speed mixers, preferably pan or turbine type shall be used for mixing the concrete.

14.2 The manufacture of poles shall be done under suitable cover and not in the open.

14.3 The concrete shall be thoroughly mixed and consolidated.

14.4 The freshly cast poles shall be protected during the first stage of hardening form the harmful effects of sunshine, dry winds, cold and rains.

15) De tensioning of Wires:

15.1 The anchoring system shall provide a device for gradual de tensioning of the wires. No back pulling of the wires shall be permitted in the gradual de tensioning device for the purpose of release of any wedge or other parts of the de tensioning device. Flame cutting of the wires before release of the full tension shall be strictly prohibited.

15.2 The transfer of prestress shall not be effected until the concrete in the poles has attained the specified as established of cube tests.

Curing:

16.1 The curing shall be done on a saturated steam at 65 degree centigrade to ensure that 80% ultimate strength is reached in 6 hours. Thereafter the

HT wires will be cut, poles demoulded and transferred to water for 14 days curing.

16.2 During manufacture, periodical tests on concrete cubes of preferably spun hollow cylindrical specimen measuring 200mm in dia and 300mm in height shall be carried out till the concrete achieves the required strength at transfer. Thereafter the test on concrete shall be carried out as detailed in IS:1343 or any other equivalent international standards. The manufacturer shall supply when required by the purchaser results of compressive test conducted in accordance with IS:456 or any other equivalent International Standards on concrete cubes made from the concrete used for the poles. If the purchaser so desires the manufacturer shall supply cubes for test purpose and such cubes shall be tested in accordance with IS:456 or nay other equivalent International Standards.

17) Earthing:

17.1 Earthing shall be provided by 6mmΦ MS Earth Rod embedded in Concrete with M16 MS Nut as shown in Drawing.

17.2 Earth wire shall not be allowed to come in contact with the pre-stressing wires.

18) Finish:

18.1 Poles shall be free from surface defects including hair cracks. The surface of the poles in contact with the steel mould shall be smooth and regular in shape and shall as far as possible, be free from pores. Water retaining pockets or honey-combing formation shall not be admissible. 25mm thick 1:2 cement mortar cover shall be provided on the full area of the top of pole.

18.2 The ends of the pre-stressing wire shall be cut as close to the surface of the pole as possible and in any case shall not project more than 3mm.

18.3 The ends of the pre-stressing wire shall be given two coats of suitable anti-corrosive paints approved by the purchaser.

18.4 No touching up or finishing by cement grout, etc., shall be done on the poles after it is removed from the moulds.

18.5 A metallic base plate shall be provided at the bottom of pole.

19) Welding and Lapping of Steel:

The high tensile steel wire shall be continuous over the entire length of the tendon. Welding shall not be allowed in any case. However, joining or coupling may be permitted provided the strength of the joint of coupling is not less than the strength of each individual wire.

20) Provision of Holes & Hooks:

20.1 Through holes shall be provided for fixing cross arms and top clamp as specified by purchaser.

20.2 PVC inserts shall be provided at intervals of 600mm on alternate sides for fixing up of step bolts along the length of pole.

20.3 A set of step up bolts shall be supplied along with each lot of 100 poles.

21) Tests:

21.1 During manufacture, tests on concrete shall be carried out as detailed in clause 16.2 of this specification.

21.2 Transverse strength test.

21.2.1 Poles made of ordinary Portland cement shall be tested on the completion of 28 days and poles made from rapid hardening cement only on the completion of 14 days after the day of manufacture.

21.2.2 The pole may be tested in either horizontal or vertical position. If tested in horizontal position, provision shall be made to compensate for the overhanging weight of the pole. For this purpose, the overhanging portion of the pole may be supported on a movable trolley or similar device.

21.2.3 The pole shall be rigidly supported at the butt end for a distance equal to the agreed depth of planting i.e. **1.8 mtr.**

21.2.4 Load shall be applied at a point 600mm from the top of the pole and shall be steadily and gradually increased to the design value of the transverse load at first crack. The deflection at this load shall be measured.

21.2.5 A pre-stressed concrete pole shall be deemed not to have passed the test if visible cracks appear at a stage prior to the application of the design transverse load for the first crack.

21.2.6 The load shall then be reduced to zero and increased gradually to a load equal to the first crack load plus 10% of the minimum ultimate transverse load and held up for 2 minutes. This procedure shall be repeated until the load reaches the value of 80% of the minimum ultimate transverse load and thereafter increased by 5% of the minimum ultimate transverse load until failure occurs. Each time the load is applied, it shall be held for 2 minutes. The load applied to pre-stressed concrete pole at the point of failure and shall be measured to the nearest five kilograms.

21.2.7 The pole shall be deemed not to have passed the test if the observed ultimate transverse load is less than the designed ultimate transverse load.

22) Sampling and Testing:

22.1 scale of sampling:

22.1.1 Lot-In a consignment, 500 poles or part there of the same mounting height, same dimensions and belonging to the same batch of manufacture, shall be grouped together to constitute a lot.

22.1.1.1 Sub-Lot: If the number of poles in a lot exceeds 500, the lot shall be divided into a suitable number of sub-lots such that the number of poles if any, sub-lot shall not exceed 500. The acceptance or otherwise of a sub lot shall be determined on the basis of the performance of samples selected from it.

22.1.2 The number of poles to be selected from a lot or a sub lot shall depend upon its size and shall be in accordance with col. 1 and 2 of the following table:

Size of lot	Dimensional Requirement		
	Sample Size	Permissible No. of Defective Samples	No. of poles for transverse strength test
(1)	(2)	(3)	(4)
Upto 100	10	1	(*)
101 to 200	15	1	3
201 to 300	20	2	4
301 to 500	30	3	5

(*) The No. of Poles to be tested shall be subject to confirmation by inspecting staff.

22.1.3 These poles shall be selected at random, in order to ensure randomness, all the poles in the lot or the sub-lot may be arranged in a serial order and starting from any random pole, every 'r'th pole may be included in the sample, 'r' being the integral part of N/n where N is the size of the lot or the sub-lot and 'n' is the sample size.

22.2 Number of Tests:

22.2.1 All the poles as selected in 22.1.2 shall be tested for overall length, cross-section and uprightness. The permissible tolerances shall be +/- 15 mm on over all length, +/- 3mm on cross sectional dimensions and 0.5% on uprightness.

22.2.2 The number of poles to be tested for transverse strength test shall be in accordance with col. 4 of the table in 22.1.2. These poles may be selected from those already tested in 22.2.1.

22.3 Criteria for Conformity:

22.3.1 A lot or sub-lot shall be considered as conforming to this specification if the conditions under 22.3.2 and 22.3.3 are satisfied.

22.3.2 The number of poles which do not satisfy the requirements of overall length, cross-section and uprightness shall not exceed the corresponding

number given in col.3 of the Table under clause 22.1.02. If the number of such poles exceeds the corresponding number, all poles in the lot or sub-lot shall be tested for these requirements., and those not satisfying the requirements shall be rejected.

22.3.3 All the poles tested for transverse strength test shall satisfy the requirements of the test, if one or more poles fail, twice the number of poles originally tested, shall be selected form those already selected and subjected to the test. If there is no failure among these poles, the lot or the sub-lot shall be considered to have satisfied requirements of this test.

23) Marking:

The poles shall be clearly non removable paint and indelibly marked with the following particulars either during or after manufacture but before testing at a position so as to easily read after erection in position:

a. Month and year of manufacture.
b. Transverse strength of pole in kg.
c. Serial number of the pole.
d. Position of center of Gravity of the pole with the word C.G.
e. Line indicating depth of planting.
f. BESCOM

General Manager, Ele.,
Procurement, BESCOM.